HVAC: Air Side Economizers

Description

This measure would revise the threshold system size for which an air-side economizer is required, taking the climate into consideration. Currently, Title 24 requires an air-side economizer on any system above a certain size, regardless of where it is located. In climate zones with hot daytime temperatures and very cold nights (e.g. Barstow), an air-side economizer is rarely useful and therefore not cost effective. Similarly, in milder climates, air-side economizers may be cost effective for a given system, but are not required because the system falls under the size threshold.

Also, this measure would incorporate economizer damper leakage requirements from ASHRAE/IES Standard 90.1-2001 into Title 24. These requirements are as follows:

6.3.1.1.4 Dampers. Both return air and outside air dampers shall meet the requirements of 6.2.3.3.4.

6.2.3.3.4 Dampers. Where outdoor air supply and exhaust air dampers are required by Section 6.2.3.2.3, they shall have a maximum leakage rate when tested in accordance with AMCA Standard 500 as indicated in Table 6.2.3.3.4.

TABLE 6.2.3.3.4 - Maximum Damper Leakage

Climate	Maximum Damper Leakage at 1.0 in w.g.cfm per ft ^{2}	
	Motorized	Non-motorized
HDD65>7200 or CDD50>7200	4	Not allowed
HDD65<2701 and CDD50<3601	20	20[a]
All others	10	20[a]
Notes:		

Benefits

The benefit of this measure is reduced energy consumption achieved by geographically shifting the installed base of air-side economizers to locations where they will be more frequently used.

Leakage testing helps to ensure the energy efficiency of the damper. An economizer employs dampers to deliberately separate air streams of different temperatures. When the damper leaks, the temperature difference, and therefore the energy benefit, is reduced.

Environmental Impact

The change has a positive environmental impact by reducing energy use, increasing the use of air-side economizers in climates where they are cost effective, and reducing the use of air-side economizers in climates where they are ineffective.

Type of Change

The proposed change is a modification of an existing prescriptive requirement. Section 144 E1 would be modified with a table that presents minimum system size for requiring an air-side economizers by climate.

This measure will require changes in the Compliance Forms, ECM and ACM Manual.

Measure Availability and Cost

Prefabricated air-side economizers for small units are primarily manufactured by CanFab and Micrometal. For large units, economizers are built from components by the major air-handling unit manufacturers. The baseline condition is that air-side economizers are required for systems above a certain size regardless of climate. For life cycle cost analysis, the measure will be compared to the current ***Standards***.

In general terms, air-side economizers for five to 10 ton units cost roughly $900-$1,200, not including the cost of installation.

Useful Life, Persistence and Maintenance

Air-side economizers are notorious for failures in the field. No existing standards for economizer performance or construction can be applied to improve reliability. Nonetheless, if we assume that the failure rates are evenly distributed across all economizers in California, this measure still represents an improvement.

Table 1 – Effect of Failure Modes

	Failure Mode "Open"	Failure Mode "Closed"
Hot Climate	**Bad.** Hot air is introduced into the system and unnecessary cooling energy is wasted	Not too bad. Benefit of economizer goes away but this is a small loss due to the few hours of operation.
Mild Climate	Not too bad. Warm air may be introduced on an infrequent basis	Significant loss of free cooling, the benefit of the economizer goes away

Table 1 shows the effects of the two failure modes - "open" and "closed" - in two climate types, hot and mild. The penalty of failure "open" in a hot climate is dramatic, while the penalty of failure in other climates is not so bad. The proposed measure reduces or eliminates air-side economizers in hot climates where the failure penalties are big, and increases usage in mild climates where economizer benefit is large but failure penalty (loss of free cooling) is small. As noted in the table, a significant loss of free-cooling occurs when an economizer fails shut in a mild climate.

Performance Verification

Costs will be added to the measure for performance verification. Specification performance verification is part of a New Buildings Institute PIER project. Persistence of energy savings will likely be affected by failure rates, even when performance verification has occurred.

Cost Effectiveness

The measure will be shown to be cost effective through life cycle cost analysis. Cost data will be collected for economizers of various sizes. Simulations on packaged single units with and without economizers will be performed for different climates. The simulation results (energy cost savings) will be scaled to the tonnage (size) of the unit.

Damper leakage will be assessed as follows: Both the minimum and maximum positions in the air-side economizer model will be varied to simulate leakage at both fully open and minimum position conditions. A model of energy cost penalty as a function of the amount damper leakage will be developed. The costs of the damper measures required to meet the proscribed leakage levels will be collected, and then it will be determined if this measure is life-cycle cost effective.

Analysis Tools

Building simulations and life cycle cost analysis will determine the system size breakpoints for each climate.

Relationship to Other Measures

The trade-off table for air-side economizers may need to be regenerated. The ACM Manual will need to be changed.

Bibliography and Other Research

ASHRAE 90.1 incorporates a table similar to the one proposed in this measure, but it is not adjusted for California climates.

Johnson, J and Potter, A. Method of Verifying Performance into California's Nonresidential Energy Standards: Opportunities and Obstacles, National Conference on Building Commissioning, May 2001, PECI, Inc.